

# On Sign Language and the Mora — Is the Mora Necessary in Sign Language? —

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**Key words:** movement position model (MP model), move-hold model (MH model), mora, obligatory contour principle (OCP), compensatory lengthening (CL)

## Abstract

There are a number of ways to show sign language in phonology. Two of these are the MP model (the Movement Position Model) and the MH model (the Move-hold Model), which are compared in this paper in order to determine which model is more appropriate. By way of example, the lengthening of the initial hold can be given when the words in sign language are emphasized. It must be considered whether phonology or phonetics is more suitable to explain sign language. It can be found difficult to use the MP model because this model consists of syllables which involve moras that are units of weight which connect with the onset. A mora is generally defined as the unit of time which is equivalent to the ordinary or normal short sound or syllable. If it is explained by phonetics, the initial long hold can be considered as an allophone in the MP model, which is not problematic. The MH model, alternatively, is desirable because it does not have any moras, but sign language cannot be compared with spoken language using the MH model in which no mora is used. Even if such an example is considered an allophone and does not have any relation to phonology, it is still extremely difficult to compare sign language with spoken language.

## Introduction

These days, many phonologists study sign language phonology, and the number of works on the autosegmental structure of sign language has gradually been increasing. For example, the Move-hold Model (MH) [1-4], the Hand Tier Model (the Movement Location Model) (ML) [5-9], and the Moraic Model (Moraic Theory of Syllable Structure, the Movement Position Model) (MP) [10-12] are typical. Although most of them have syllables, there are various opinions as to whether the mora, which is generally defined as the unit of time equivalent to the ordinary or normal short sound or syllable, exists or not. Liddell (1993) denies the existence of the mora [3]. He says that the MH model has not been used to represent syllable structure, but in this paper, the view is taken that it is better to consider the phonological unit of the MH model to be a syllable.

The reason why we introduce syllable structures into sign language is that we can easily explain sign language when we compare it with spoken language. Suppose there is also a mora in the sign language structure, then we can consider that sign language has the same phonological style as spoken language,

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and it can therefore be explained more easily.

It is not surprising that before the advance of sign language phonology, spoken language and sign language were explained separately. In the former language, the articulation point is from the lip or the nose to the throat, and voiced sounds are distinguished from voiceless sounds through the vocal cords, and stressed by contraction of internal intercostals with a mora introducing the stress. Stokoe (1960) says that sign language is produced by the positions of both hands and their movements, so we understand that the language is utterly different from spoken language [13]. Battison (1978) adds hand directions to the positions [14]. If we can explain these two languages which are different from each other by comparing their similarities as above, we can describe sign language more systematically and structurally. If the mora which plays an important role in the autosegmental phonology of spoken language can also be found in sign language, several phonological phenomena can be explained using it. We have to make sure whether or not the existence of the mora really can also be recognized in sign language.

It must first be considered how sign language is to be explained by the syllable structure of spoken language. According to some phonologists like Perlmutter and Hayes, the syllable structure of sign language consists of P and M, which refer to the position and movement of the hands, each corresponding to a consonant and vowel of spoken language. The phonological phenomena of acquisition of stress by heavy syllables and of compensatory lengthening are explained by the mora in the syllable structure of spoken language. Are such phenomena also true of the sign language structure?

Expositions begin in § 2 with the structure of sign language, and in § 3 and § 4 indicate that the Sonority Sequencing Principle (SSP) can be used to explain the structure of sign language as it can be seen in spoken language; this provides the evidence that sign language also has a syllable structure. In § 5, there is a consideration of the definition of the mora, and in § 6 an argument for the necessity of the mora in the sign language structure using the Obligatory Contour Principle (OCP) and Mora Insertion (MI) is posited. In § 7, a phonetic solution is proposed to explain the phenomena in the syllable structure which are hard to explain phonologically. Finally, the Compensatory Lengthening (CL) as another phonological phenomenon in § 8 is considered.

### The syllable structure of sign language

Corina and Sandler (1993) divide the movements of sign language into three: path movements, local movements and secondary movements [9]. The first movements are also referred to as primary movements, which displace the entire hand from one spatial or body location to another. The sign INTELLIGENT, for example, contains a straight path movement from the forehead to a location some distance away from it.

Second, local movements are the ones which arise from changes affecting only hand postures (either handshapes or palm orientations). Corina and Sandler say that movements limited to changes in hand posture are termed local movements or internal movements and that local movements create signs with two discrete surface handshapes or palm orientations. They also say that local movements may occur in the absence of path movements, or they may accompany them.

The last major type of movements in sign language are generally referred to as secondary movements. Corina & Sandler explain these as the movements which are not fully agreed upon by all authors, but may generally be described as including at least repeated hand posture changes. The repeated changes may involve bending at selected knuckles (e.g. hooking and bending movements), or finger rubbing and finger flicking movements.

Perlmutter (1993) says secondary movements can occur while the hand executes a path movement [11],

and that Friedman’s (1977) “micro movement” [15]; Klima and Bellugi’s (1979) “hand internal movement” and “local movement” [16]; the “local movement” of Liddell (1984, 1990) [1, 2], Wilbur (1987) [17], and Liddell and Johnson (1989) [4]; and Sandler’s (1989) “handshape internal movement” [7] all include the movements treated as a “secondary movement” here. He also says that he follows Liddell (1990) [2] and Liddell and Johnson (1989) [4] in treating secondary movement and handshape changes as separate phenomena.

As we can see above, each author has a different opinion about the movements of sign language, and uses different terms to describe them. Even the same term, furthermore, sometimes has different meanings or definitions, which can be confusing. In this paper, the views of Corina and Sandler are followed, and they explain the phenomena of sign language using path movements, local movements and secondary movements.

Of these movements, only path movements (to be explained in detail later) are indicated as Ms (movements) in the MP model, and can work as nucleuses in the syllable of spoken language. Path movements in sign language play the part of vowels in spoken language. Neither local movements nor secondary movements can become Ms, and they occur with Ps (place), which correspond to consonants in spoken language.

It has already been stated that the movements of sign language can be compared with sounds of spoken language if we can explain sign language by syllable structures with moras, but are there any examples which support the syllable structures of sign language?

### The SSP

Bell & Hooper (1978) propose the SSP [18], which has been named Sonority Sequencing Generalization by Selkirk (1984) [19].<sup>†1)</sup>

In the SSP, a sonority scale can be proposed as shown below in Table 1, where the most sonorous elements are given the highest value and the least sonorous the lowest one. The sonority value is the highest in a nucleus and lower in an onset or a coda.

Some examples are given using the sonority scale of Table 1. In Fig. 1, which is adapted from Hogg & McCully (1989) [20], the sounds of words are replaced with the figures of sonority values under the phonetic symbols, and each word is divided into syllables with brackets. Ambisyllabic sounds are indicated as **【 ... - X - ... 】**, where **【 ... - X 】** is one syllable and **【 X - ... 】** is the other, **【 X 】** means ambisyllabic.

Table 1 sonority scale (Hogg & McCully 1989) [20]

sounds	sonority values
low vowels	10
mid vowels	9
high vowels	8
flaps	7
laterals	6
nasals	5
voiced fricatives	4
voiceless fricatives	3
voiced stops	2
voiceless stops	1

modest	complain	petty	elastic
/modest/	/komple:n/	/peti/	ilæstik/
<b>【 5-9-2 】【 9-3-1 】</b>	<b>【 1-9-5 】【 1-9-6-5 】</b>	<b>【 1-9-【 1 】-8 】</b>	<b>【 8 】【 6-10-3 】【 1-8-1 】</b>
elasticity	petrol	button	bottle
/i:læstisiti/	/petrəl/	/bʌtn/	/botl/
<b>【 9 】【 6-10-3 】【 1-8-3 】【 8 】【 1-8 】</b>	<b>【 1-9-1 】【 7-9-6 】</b>	<b>【 2-9-【 1 】-5 】</b>	<b>【 2-9-1 】【 6 】</b>

Fig. 1 examples of words assigned sonority values

For example, in “petty” and “button”, each consists of two syllables, **【 1-9-1 】** and **【 1-8 】**, and **【 2-9-1 】** and **【 1-5 】**.

In “modest”, there are two syllables, which are **【 5-9-2 】** and **【 9-3-1 】**, and the number 9 is the nucleus of each syllable and represents a mid vowel. The numbers 5 and 2 in the former syllable are each an onset and a coda, and a nasal and a voiced stop, and 3 and 1 in the latter are the codas, which are a voiceless fricative and a voiceless stop. In the word “bottle”, the [l] sound is a consonant, but the sonority value is higher than that of the [t] sound and the [l] is formed as one syllable by itself. Supposing that sign language has sonority, too, there is a high possibility that it can be explained with a syllable and a mora.

### The SSP for sign language

Does sign language have sonority like spoken language does, and if so, can the phenomena of sign language be explained by the sonority? If the SSP is true of sign language phonology, sign language may have the same syllable structures as spoken language. Sandler (1993) shows the sonority values of sign language as follows [8].

In Table 2, path M, TIM and IM mean a path movement, a trilled internal movement and an internal movement respectively. Contacting M is either a secondary movement or a local movement, which is different from a path movement, with the main hand making contact with the body. An L means location, and a plain L has neither any movement nor contact. The difference between a plain L and a contacting L is in whether the main hand makes contact with the body or not.

Table 2 an ASL phonetic sonority hierarchy

hand location or movement	sonority values
path M with TIM	8
path M with IM	7
path M	6
non-path M with IM	5
contacting M	4
L with TIM	3
plain L	2
contacting L	1

Some examples from Sandler (1993) are shown as follows [8]. In “mind”, the right index finger moves from just in front of the right temple to a location in contact with the temple. When the movement is indicated using sonority values, the right index finger being some distance from the right temple without

any movement is 2, the path movement from the place to the temple is 6, and the contact with the index finger is 1. The sequence of sonority values in the word “mind” is shown in [2-6-1]. In “drop” as another example, the movement is that both hands placed in front of the chest are lowered and moved further apart. Considering sonority values, the conditions that both hands are placed in front of the chest without any movement or contact indicate 2, and the path movement of the hands being widened is 6, and 2 is assigned because the hands are held in front of the stomach. The sequence of sonority values in the word “drop” is shown in [2-6-2].

We understand that as sonority value is proportional to the degree of movement, sign language can be explained by the SSP, which means that sign language has syllables as does spoken language. Even though sign language has syllable structures, however, there is no guarantee that they have moras.

### Syllable structure and moras

In this and the next section, I consider the existence of the mora. If it is proved that the mora exists in the syllable of sign language, we can explain where to stress as well as CL [21], and can also make comparisons with spoken language.

What exactly is a mora? Some phonologists regard or define it as “weight”, and others as “length”. Spoken language has two kinds of syllables, heavy and light syllables. When a mora is taken as weight, only a heavy syllable can be stressed because the mora attracts stress. Heavy syllables are easier to stress than light syllables. It is also possible to take a mora as length, and the sound duration of a heavy syllable is longer than that of a light syllable. As Kubozono (1995) says, however, the individual length of phonemes with moras is not the same [22]. He says that the opposition of the quantity of sound changed into that of the quality of sound during the evolution of English, and that in phonetic notation [i:] changed into [i] and then [I], which cannot be explained by the opposition of two moras versus one mora. In this paper, as there is no evidence for a mora to be taken as length (although some may take this view) the phonological phenomena like stressing and CL using the mora as weight is considered.

According to the number of moras, syllables are divided into a syllable to be stressed and one which is not stressed in spoken language; a heavy syllable and a light syllable. Is this also true of sign language? To begin with, let’s consider whether a syllable holds a mora or not.

### Syllable structure of sign language

There are several prosodic models of ASL (American sign language) including the MH model, Hand Tier Model and the MP model. Liddell (1993), who proposes the MH model, demonstrates that there are a number of phenomena which we cannot explain using the MP model [3]. Hayes (1993) compares his proposed revision of the MP model with Liddell’s proposition [12].

Liddell shows some examples of ASL, in which a mora has to be inserted in the phrase-final position by the MI rule.<sup>†2)</sup>

He takes the example of GOOD using the MP model in Fig. 2, explaining that a mora is inserted by MI in the phrase-final position, which has a hold. In this case, a coda is connected solely with a mora, which is not problematic because a coda may have weight in spoken language. The MP model can explain this case in Fig. 2. In the MP model, however, COLOR has no path movement, but two moras have to be given to the P of phrase-final position in Fig. 3 (b), which is correspondent to a consonant in spoken language. This seems strange because a consonant cannot have two moras in spoken language.

In spoken language, “dle” of “noodle” and “mal” of “normal” function as syllables, although they don’t



Fig. 2



Fig. 3

contain any vowels. This is because “l” of “dle” or “mal” fulfills the role of a nucleus like a vowel, and a P of sign language is also assumed to be a nucleus. But as “l”, which is not a vowel, cannot have two moras, it is not assumed that only P can.

The same thing is true of a hold which P has in an onset, when the word is emphatic. For example, UNDERSTAND usually has two signs, one of which is with a path movement and the other without one. They can be expressed in syllables of the MP model.<sup>†3)</sup>

When the syllable is emphasized and an initial onset has a long hold, though, it leads us to the wrong conclusion that a mora has to be given to the onset; as an onset has nothing at all to do with weight, it should have no mora. It is impossible to explain UNDERSTAND using the MP model because an onset has to hold a mora. Liddell says that the phonetic phenomenon which cannot be explained by using the MP model can be shown by using the MH model, although in fact, he does not indicate it in Liddell (1993) [3].

Liddell also states that the MH representation has little in common with the MP representation, and that it has not attempted to represent syllable structure, but has three tiers instead.<sup>†4)</sup> He also says the following:

The highest level represented is the skeletal tier. In addition to the skeletal tier, the MH representation includes several melody tiers which contain articulatory features specifying hand configuration, orientation, the relevant locations involved in the production of the sign, and features which place the hands with respect to those locations. When there is only a single entry on a melody tier, the features on that tier will spread to every segment of the sign.

The structure of the MH model is not syllabic according to his statement, but the terms “skeletal tier” and “melody tier” are from the syllable structure of Metrical Phonology (Hogg and McCully 1989, Goldsmith 1990) [20, 23].<sup>†5)</sup> In the MH model, an M exists even though there is no path movement. Liddell tries to explain sign language using not the mora but handshape, location, hold and movement. That is

how the MH model explains the initial hold of a word (or syllable).

Hayes (1993) proposes revision of the MP model by comparing it with the MH model [12].<sup>†6)</sup> Each mora in the MP model is attached to each syllable without any path movement, and only a P that corresponds with a consonant in spoken language makes association lines reach moras in two syllables, which seems strange because no consonant attaches to plural moras in the light of spoken language phonology. Also, a consonant is never attached to two nucleuses at a time.

Can we say that each mora should have an individual P, if we then explain these phonological phenomena using the MP model in some way? What if each P is attached to a nucleus as in the example of “l” in spoken language? Two syllables which each have only a consonant, however, never stand next to each other as in Fig. 4.

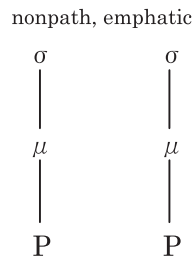


Fig. 4 UNDERSTAND

In Fig. 4, the principle known as the OCP, which was first proposed by Goldsmith (1979), is violated [24]. The OCP is a principle that prohibits consecutive or adjacent identical segments.<sup>†7)</sup> In the MP model the two adjacent syllables without any path movements are banned by the OCP.

Let us now consider how the syllable structure with a path movement and a hold is shown in the MP model where an initial P has a long hold by emphasis. There seem to be two ways to explain the structure. One way is to use the MI rule. A mora is inserted into the initial of a syllable by the MI rule, and an association line from the P of onset is connected to the mora. The syllable is then divided into two by resyllabification because the onset of the syllable has a mora as in Fig. 5; the word which is not given a hold yet has only one syllable. When it is given a hold by emphasis, a mora is attached to the syllable, but since an onset cannot be dominated by a mora, the syllable is divided into two by resyllabification. But the P of an onset is dominated by two moras and is banned.

Both Fig. 2 and Fig. 5 are the syllables shown by Hyman (1985), so we are apt to believe, mistakenly, that a P is dominated by a mora and has weight [26]. The syllable structures indicated by Hayes (1982) make it possible to explain that the P as an onset is not dominated by any mora, but is attracted by the mora that is inserted in front of the syllable by MI to be a nucleus of a new syllable, and that as a result the word consists of two syllables in Fig. 6 [27].<sup>†8)</sup> The P is ambisyllabic in this case.

The other way is to use Extrametricality, which is from Hayes (1985) [28].<sup>†9)</sup> It is assumed that a mora is attached to a P as an onset originally but it does not appear only if the syllable is not given a stress. It is also assumed that the mora appears only in the case of stressing the syllable, and the syllable is resyllabified and divided into two to be released into the surface structure as in the case of MI. While Extrametricality is being applied, phonological rules are not applicable to the extrametrical mora. When the syllable does not have any emphasis, Extrametricality is still effective in the mora and so the mora doesn't appear in the surface structure. When the syllable has a stress, Extrametricality is removed and the mora appears.

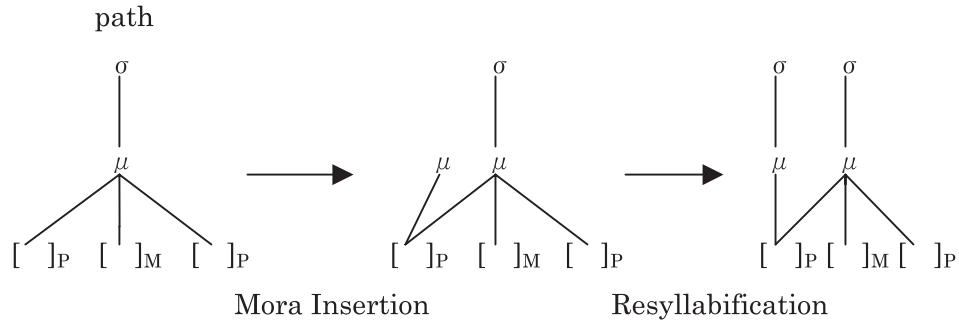


Fig. 5 UNDERSTAND

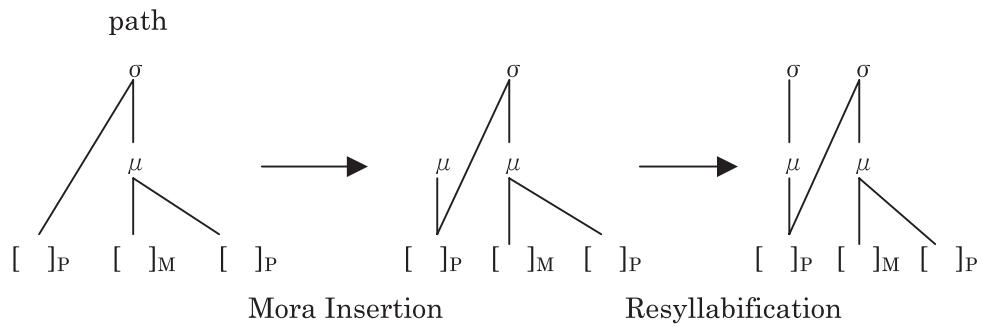


Fig. 6 UNDERSTAND

Jun (1994) gives the example of Extrametricality in Korean to explain Partial Reduplication [29]. He shows that the rule “Partial Reduplication” is applicable only to onomatopoeic words of Korean. After the application of the rule, the mora is set free and appears in the surface structure. Even though the syllable [paŋ] is reduplicated by the rule of partial reduplication, [ŋ] of the coda doesn’t appear in the surface structure because [ŋ] is applied by Extrametricality. After the application of the phonological rule,

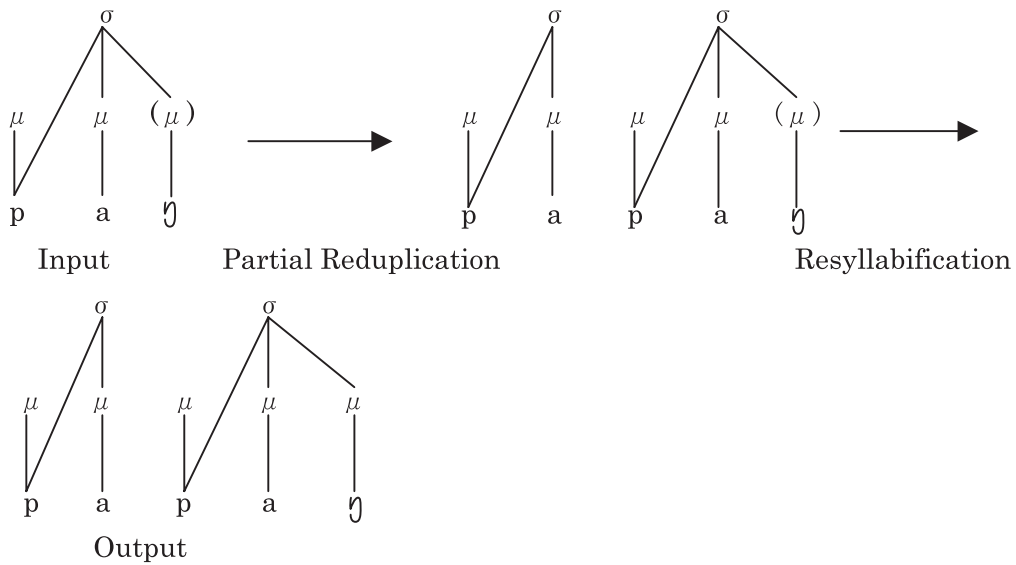


Fig. 7 [p'apaŋ]



however, Extrametricality of the mora in the coda which has existed since the input is taken away, and the mora appears in the surface structure.

These solutions, however, are problematic in that both MI and Extrametricality have to be applied not to the initial but to the final position of the word. Liddell (1993) says that a rule of MI applies in the phrase-final position, to produce the surface forms in which a movement is followed by a hold [3]; and Hayes (1985) says that the unmarked edge for Extrametricality is the right edge, and the left edge is the marked edge [28]. Crystal (1991) also says that Extrasyllabic (ity) may refer to segmental material appearing in word-final position which cannot be syllabified according to the principles that appear to hold word-internally [30]. Here Extrasyllabic (ity) is the same rule as Extrametricality, and the naming of this rule differs with each individual author. Extrametricality applies only in the right edge of a syllable as in Fig. 7. As a result, solutions such as Mora Insertion and Extrametricality find it difficult to explain the initial long hold of the word UNDERSTAND with path movement.

### Phonetic solution

As mentioned above, it is extremely difficult phonologically to explain the phenomenon of a long hold in the position of onset in sign language. How then can it be explained?

The only possible solution is that both a hold and a long hold in the onset are not attached independently to any mora and that they are assumed to have the same structure. As we have seen above, a mora should not be regarded as length but as weight, and it can be thought that the difference of length is attributed only to phonetics. As Sakurai (2005) says, the difference of length depends on emphasis and the position of words in the sentence, and whether it is a hold or a long hold, there is no difference of the meanings and structures. It seems to be a problem of phonetics and should be considered specifically to be the problem of allophones [31]. An allophone (originally a term of Structural Linguistics), refers to a sound that varies according to the place and conditions in spoken language. For example, the length of [p] in “put” which is spoken at medium speed is different from that spoken at slow speed in order to stress it, but there is no difference in meaning. The length of closure is in proportion to the degree of bilabial explosion. It can be true of sign language, too. The cases of the stop and the hold which are lengthened in the position of an onset by emphasis or in the position of a coda in the phrase-final position in spoken and sign language are not in the domain of phonology, but of phonetics, because these sounds are thought to be allophones. If it is a problem of allophones, we can also use the MP model because that model comes from phonetics.

### CL †<sup>10</sup>)

If the syllable of sign language corresponds to that of spoken language, the rules in spoken language should also be applicable to sign language. CL, for example, one of the typical phonological rules of spoken language, applies to the syllable where a phoneme connected to a mora is deleted, to prevent the mora from being suspended. Then in the same syllable a nucleus next to the position of the lost phoneme extends an association line to the remaining mora. In sign language, even if a P in the position of a coda is deleted, unlike spoken language there is no mora left in the syllable. This is because the P’s deletion means that path movement disappears. In other words, as path movement needs two places (path movement is the movement from one place to another), if one place is deleted it means that the hands must stay in the same place.

Considering that CL, which is a rule of spoken language, cannot be applied to sign language, it does not seem to be significant to make use of the mora in sign language.

Conclusion

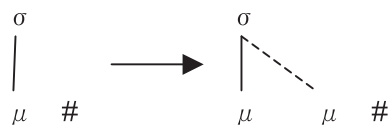
There are several works in which sign language is explained by the mora and the syllable as in spoken language. If we could consider sign language using the same framework, it would be possible to explain it by comparing it with spoken language. But, as mentioned above, in fact it seems to be difficult to show it using the mora as in spoken language. It may be unrealistic to take a vowel and a consonant in spoken language for a path movement and a place in sign language, because there is a great difference in the way to communicate between both languages. At this stage, we have two solutions to explain the phenomena in sign language. One is to use the MP model considering the long hold of an onset to be a problem of phonetics. The other is to use the MH model without thinking about making comparisons. If such problems as an initial long hold and a phrase-final long hold are considered to be phonetic ones, the MP model is still effective using moras and syllables; however, I think it more appropriate to explain sign language using the MH model, which does not have any moras or syllables, because Ps and Ms are not thought to be the same as consonants and vowels when CL is taken into consideration.

Notes

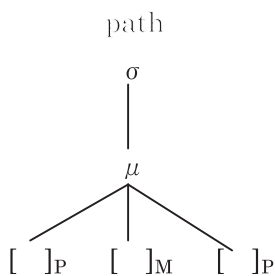
- (1) Sonority Sequencing Generalization [19]

In any syllable, there is a segment constituting a sonority peak that is preceded and/or followed by a sequence with progressively decreasing sonority values.

- (2) Mora Insertion



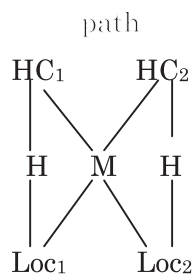
- (3) a. UNDERSTAND



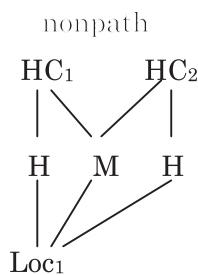
- b. UNDERSTAND



- (4) a. UNDERSTAND



- b. UNDERSTAND



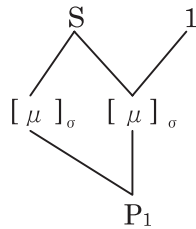
- (5) Metrical Phonology [30]

A theory of phonology in which phonological strings are represented in a hierarchical manner, using such notions as segment, syllable, foot and word. Originally introduced as a hierarchical theory of stress, the approach now covers the whole domain of syllable structure and phonological boundaries. Stress patterns are considered to reflect, at least in part, relations of prominence between syntactic

and morphological constituents. The underlying metrical structure of words and phrases may be represented in the form of a metrical tree, whose nodes reflect the relative metrical strength between sister constituents.

(6) UNDERSTAND

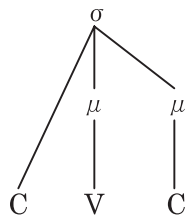
nonpath. emphatic



(7) Obligatory Contour Principle (OCP) [25]

Adjacent identical tones are banned from the lexical representation of a morpheme.

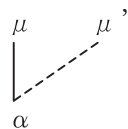
(8) Hayes (1982) [27]



(9) Extrametricality

$X \rightarrow [+ex] / \text{---}]_D$

(10) Compensatory Lengthening



※ μ' is a mora which does not connect with any phoeme.

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